Hindawi Publishing Corporation
EURASIP Journal on Wireless Communications and Networking
Volume 2006, Article ID 92039, Pages 1–3
DOI 10.1155/WCN/2006/92039

Editorial

Quality of Service in Mobile Ad Hoc Networks

Wei Li,[1] Mohsen Guizani,[2] and Demetrios Kazakos[3]

[1] *Department of Electrical Engineering and Computer Science, University of Toledo, Toledo, OH 43606, USA*
[2] *Department of Computer Science, Western Michigan University, Kalamazoo, MI 49008, USA*
[3] *Department of Electrical and Computer Engineering, University of Idaho, Moscow, ID 83844, USA*

Received 10 April 2006; Accepted 10 April 2006

Mobile ad hoc networking is a challenging task due to the lack of resources residing in the network as well as the frequent changes in network topology. Although much research has been directed to supporting quality of service (QoS) in the Internet and traditional wireless networks, present results are not suitable for mobile ad hoc network (MANET). QoS support for mobile ad hoc networks remains an open problem, drawing interest from both academia and industry under military and commercial sponsorship. MANETs have certain unique characteristics that pose several difficulties in provisioning QoS, such as dynamically varying network topology, lack of precise state information, lack of central control, error-prone shared radio channels, limited resource availability, hidden terminal problems, and insecure media, and little consensus yet exists on which approaches may be optimal. Future MANETs are likely to be "multimode" or heterogeneous in nature. Thus, the routers comprising a MANET will employ multiple, physical-layer wireless technologies, with each new technology requiring a multiple access (MAC) protocol for supporting QoS. Above the MAC layer, forwarding, routing, signaling, and admission control policies are required, and the best combination of these policies will change as the underlying hardware technology evolves.

In response to the above demand for mobile ad hoc networks, this special issue aims at providing a timely and concise reference of the current activities and findings in the relevant technical fields, and focuses as well on the state-of-the-art and up-to-date efforts in design, performance analysis, implementation and experimental results for various QoS issues in MANETs.

We believe that all of these papers not only provide novel ideas, new analytical models, simulation and experimental results, and handful experience in this field, but also simulate the future research activities in the area of the quality of service for mobile ad hoc networks. A brief summary of each paper is listed as follows.

The first paper by Qi He et al. first identifies two critical issues leading to the TCP performance degradation: (1) unreliable broadcast, since broadcast frames are transmitted without the request-to-send and clear-to-send (RTS/CTS) dialog and Data/ACK handshake, so they are vulnerable to the hidden terminal problem; and (2) false link failure which occurs when a node cannot successfully transmit data temporarily due to medium contention. Secondly, the authors propose a scheme to use a narrow-bandwidth, out-of-band busy-tone channel to make reservation for broadcast and link error detection frames only. The proposed scheme is simple and power efficient, because only the sender needs to transmit two short messages in the busy tone channel before sending broadcast or link error detection frames in the data channel. Analytical results show that the proposed scheme can dramatically reduce the collision probability of broadcast and link error detection frames. Extensive simulations with different network topologies further demonstrate that the proposed scheme can improve TCP throughput by 23% to 150%, depending on user mobility, and effectively enhance both short-term and long-term fairness among coexisting TCP flows in multi-hop wireless ad hoc networks.

The second paper by Deying Li et al. discusses the energy efficient QoS topology control problem for nonhomogeneous ad hoc wireless networks. Given a set of nodes with different energy and bandwidth capacities in a plane, and given the end-to-end traffic demands and delay bounds between node pairs, the problem is to find a network topology that can meet the QoS requirements, and the maximum energy utilization of nodes is minimized. Achieving this objective is vital to the increase of network lifetime. We consider two cases of the problem: (1) the traffic demands are not splittable, and (2) the traffic demands are splittable. For the former case, the problem is formulated as an integer linear programming problem. For the latter case, the problem is formulated as a mixed integer programming problem, and an optimal algorithm has been proposed to solve the problem.

The third paper by Hsiao-Hwa Chen et al. proposes autonomous power control MAC protocol (APCMP), which allows mobile nodes dynamically adjusting power level for transmitting DATA/ACK according to the distances between the transmitter and its neighbors. In addition, the power level for transmitting RTS/CTS is also adjustable according to the power level for DATA/ACK packets. In this paper, the performance of APCMP protocol is evaluated by simulation and is compared with that of other protocols.

The fourth paper by Yang Yang et al. considers the hybrid problem of the infrastructure and the ad hoc modes in WLAN. They propose in this paper a new coverage improvement scheme that can identify suitable idle MSs in good service zones as traffic agents (TAs) to relay traffic from those out-of-coverage MSs to the AP. The service coverage area of WLAN is then expanded. The QoS requirements (e.g., bandwidth) of those MSs are considered in the selection process of corresponding TAs. Mathematical analysis, verified by computer simulations, shows that the proposed TA scheme can effectively reduce blocking probability when traffic load is light.

The fifth paper by S. Ahmed et al. analyzes the performance differentials to compare the commonly used ad hoc network routing protocols. They also analyze the performance over varying loads for each of those protocols using OPNET modeler 10.5. Their findings show that for specific differentials, TORA shows better performance over the two on-demand protocols, that is, dynamic source routing and ad hoc on-demand distance vector routing. Their findings are expected to lead to further performance improvements of various ad hoc networks in the future.

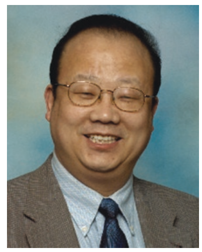
The sixth paper by Nagaraja Thanthry et al. analyzes various parameters that affect the performance of TCP in an ad hoc network environment. Congestion and path nonavailability are two major factors that affect TCP performance. It was also observed that, in the presence of multiple paths, TCP performance degrades when one of the paths used for forwarding data drops a packet. In the current paper, the authors have proposed establishing multiple connections for every data transfer between the source and the destination. The proposed mechanism would be transparent to the application and session layers; however, it involves the transport layer in multipath routing scheme.

The seventh paper by X. Wang et al. develops a modified version that we term CSMA/CCA (CSMA with copying collision avoidance) in order to mitigate fairness issues arising with CSMA/CA. A station in CSMA/CCA contends for the shared wireless medium by employing a binary exponential backoff similar to CSMA/CA. Different from CSMA/CA, CSMA/CCA copies the contention window (CW) size piggybacked in the MAC header of an overheard data frame within its basic service set (BSS), and updates its backoff counter according to the new CW size. Simulations carried out in several WLAN configurations illustrate that CSMA/CCA improves fairness relative to CSMA/CA and offers considerable advantages for deployment in the 802.11 standard based WLANs.1

The eighth paper by S. Guizani et al. proposes a new technique to compensate the chromatic dispersion optically by applying Talbot effect. Results obtained are inline with what's proposed. This method is easy to implement and versatile since any type of fiber can be used. Moreover, our technique has the strength to revive a totally deformed signal regardless of the bits transmitted.

In closing, we would like to thank the support from the Editor-in-Chief, Phillip Regalia, and the contributions from authors and reviewers, to make this special issue possible.

Wei Li
Mohsen Guizani
Demetrios Kazakos



Wei Li is currently an Associate Professor in the Department of Electrical Engineering and Computer Science at the University of Toledo, USA. He received his Ph.D. degree from the Chinese Academy of Sciences in 1994. Dr. Li's research interests are in the routing protocols and security in wireless internet and mobile ad hoc networks; algorithms, complexity, power connectivity and coverage in wireless sensor networks; adaptation, design and implementation of dynamic models for wireless and mobile networks, and so forth. He has published over 60 peer-reviewed papers in professional journals, over 30 referred papers in the proceedings of professional conferences, and 3 books. Dr. Li is currently serving as an Editor for EURASIP Journal on Wireless Communications and Networking, for International Journal of Computer and Their Applications, for International Journal of Sensor Networks, and for International Journal of High Performance Computing and Networking. He was once a recipient of Hong Kong Wang Kuan Cheng Research Award in 2003 and US Air Force Summer Faculty Fellowship in 2005.

Mohsen Guizani is currently a Professor and the Chair of the Computer Science Department at Western Michigan University. He received his B.S. (with distinction) and M.S. degrees in electrical engineering; M.S. and Ph.D. degrees in computer engineering in 1984, 1986, 1987, and 1990, respectively, from Syracuse University, Syracuse, New York. His research interests include computer networks, wireless communications and mobile computing, and optical networking. He currently serves on the editorial boards of six technical journals and is the Founder and EIC of Wireless Communications and Mobile Computing Journal published by John Wiley (http://www.interscience.wiley.com/jpages/1530-8669/). He is also the Founder and General Chair of the IEEE International Conference of Wireless Networks, Communications, and Mobile Computing (IEEE WirelessCom 2005). He is the author of three books and in the process of writing another two. He guest edited a number of special issues in journals and magazines. He also served as a Member, Chair, and General Chair of a number of conferences. He has more than 140 publications in refereed journals and conferences. He received both the Best Teaching Award and the Excellence in Research Award from the University of Missouri-Columbia in 1999 (a college-wide competition). He won the Best Research Award from KFUPM in 1995 (a university-wide competition). He was selected as the Best Teaching Assistant for two consecutive years at Syracuse University, 1988 and 1989. He is an active Senior Member of the IEEE, Member of the IEEE Communication Society, IEEE Computer Society, ASEE, ACM, OSA, SCS, and Tau Beta Pi.

Demetrios Kazakos received an M.A. degree from Princeton University in 1970 and a Ph.D. degree from the University of Southern California in 1973, in electrical engineering. In 1992, he was elevated to the grade of a Fellow of the IEEE for his research in two areas: enhanced algorithms for multiuser multiaccess networks and statistical pattern recognition. He has always been a very active participant in IEEE conference organizing and editorial activities. He was Editor of the IEEE Transactions on Communications for 5 years, Technical Program Chair for two major IEEE Conferences, and member of the Technical Program Committee for numerous IEEE conferences. In 1983 he started a new company named HITEC, inc, which undertook several research and development projects in information technology, funded by the U.S. Department of Defense and the European Community. He held several Professorships for 25 years and Department Chair positions for a total of 6 years. At present he is Professor and Chair of the Electrical and Computer Engineering Department of the University of Idaho. Overall, he has published about 165 refereed journal papers, book chapters and conference proceeding papers, as well as two books. At present, he is in three Editorial Boards, and continues to participate in many technical program committees for several conferences.